Experimental Investigation on Partial Replacement of Coarse Aggregate With Ceramic Tile

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Abstract- *Due to the day-to-day innovations and development in construction field, the utilization of natural aggregates is increased tremendously and at an equivalent time, the assembly of solid wastes from the demolitions of constructions is also quite high. Because of these reasons the reuse of demolished constructional wastes like ceramic tile and granite powder came into the image to scale back the solid waste and to scale back the scarcity of natural aggregates for making concrete. The ceramic tile waste isn't only occurring from the demolition of structures but also from the manufacturing unit. Studies show that about 20-30% of material prepared in the tile manufacturing plants are transforming into waste Crushed waste ceramic tiles are used as a replacement to the coarse aggregates. The ceramic waste crushed tiles were partially replaced in place of coarse aggregates by 0, 30%, 35%, 40% and 45%. M25 grade of concrete was designed and tested. The mix design for various kinds of mixes were prepared by replacing the coarse aggregates at different percentages of crushed tiles. Experimental investigations like workability, Compressive strength test, split tensile strength test, Flexural strength test for different concrete mixes with different percentages of waste crushed after 7, 14 and 28-days curing period has done. It has been observed that the workability increases with increase in the percentage of replacement of crushed tiles increases. The strength of concrete also increases with the ceramic coarse tile aggregate up to 35% percentage.*

Keywords- Aggregates, cement, ceramic waste, different types of moulds

I. INTRODUCTION

In India tiles production is 100 million ton per annum within the ceramic industry, about 15%- 30% waste generated from the entire production. This waste isn't recycled in any form at present; however the ceramic waste is durable, hard and highly immune to biological, chemical and physical degradation forces so, we selected these waste tiles as a replacement material to the essential natural aggregate to reuse them and to decrease the solid waste produced from demolitions of construction.

For analysing the suitability of these crushed waste tiles, workability test was conducted for different mixes having different percentages of these materials. Slump cone test is employed for performing workability tests on fresh concrete. And compressive strength test is also conducted for 7, 14 and 28-days curing periods by casting cubes to analyse the strength variation by different percentage of this waste materials.

The usage of tile aggregate as replacement to coarse aggregate in concrete has the advantages within the aspects of cost and reduction of pollution from housing industry . The cost of concrete production will reduce considerably over conventional concrete by including tile aggregate and granite powder since it's readily available at very low cost and there-by reducing the development pollution or effective usage of construction waste.

II. LITERATURE REVIEW

[1] Naveen Prasad (2016),

Crushed waste tiles were used as a replacement to the coarse aggregates and fine aggregate. The combustion of waste crushed ceramic tiles was replaced in place of coarse aggregates by 10%, 20%, 30% and 40% and Granite powder was replaced in place of fine aggregate by 10%, 20%, 30% and 40% without changing the mix design. M25 grade of concrete was designed to organize the traditional mix. Without changing the combination design differing types of mixes were prepared by replacing the coarse aggregates and fine aggregate at different percentages of crushed tiles and granite powder. Experimental investigation is carried out. The workability of concrete increased with increase in granite powder and it has been observed that the compressive strength is maximum at 30% of coarse aggregate replacement

[2] Wadhah M.Tawfeeq (2016)

This study was investigated about the effects of using crushed tiles (CT) as coarse aggregates in the concrete mix. The technology of concrete recycling is well established

within the U.S. Recycling of ppc cement concrete, as well as asphaltic concrete, has been shown to be a cost-effective alternative for road, street and highway construction. It includes the water content, tiles and but also the gravel/sand ratio. They finalised that the water- cement ratio gradually decrease, the compressive strength increases. The paper consists of replacement of ceramic crushed tiles to 50% and 100% only. The results show that replacement of crushed tiles as coarse aggregate below 50% will have considerable properties.

[3]Parminder Singh and Dr.Rakesh Kumar Singla (2017)

A research paper on utilization of ceramic waste tiles from various industries related to ceramic tiles. in this paper partial replacement to coarse aggregate with ceramic waste has been studied. Three different grades of concrete have been prepared and tested. The results aren't appropriate with the traditional but considering the strength properties, it's advisable to use ceramic tile aggregate in concrete. It is finally concluded that, about 20% of ceramic tile usage in M20 grade of concrete is preferable.

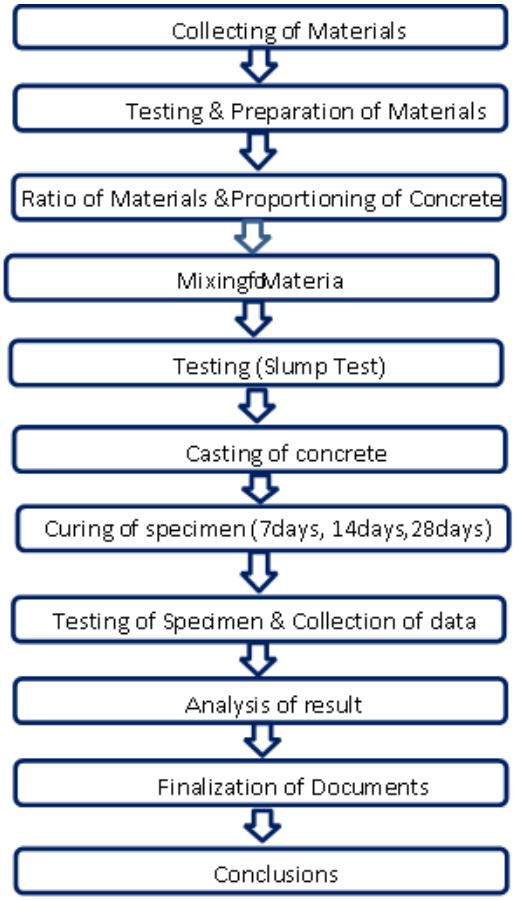
[4] Paul O. Awoyera (2018),

The usage of ceramic tiles in concrete was observed in this reasearch paper. In this paper both the fine and coarse aggregates are replaced with ceramic fine aggregate and ceramic coarse aggregates obtained from construction sites of Ota, The ceramic fine & coarse aggregates are replaced in conventional concrete individually and strength parameters are studied in depth. Finally, it states that usage of ceramic waste tiles in concrete gives considerable increase in strength compared to conventional concrete.

[5] B. TopcuAnd M. Canbaz (2019),

The amount of tile waste generation every year is enough to use in concrete as a replacement to coarse aggregate. The use of ceramic tile waste features a positive effect on environment and within the cost aspects too. By the utilization of tile aggregate, the self-weight of concrete is reduced to about 4 to 5% which makes the structure economical. Coming to the strength, the tile aggregate replacement features a negative effect on both split lastingness and compressive of concrete. But this paper studied maximum replacements of tile waste which may befurther divided into smaller percentages and may be utilized in concrete with desirable properties.

III. METHODOLGY



IV. MATERIAL

1. CEMENT

Cement has different characteristics & properties which depend upon their compositions. By changing in fineness of grinding, oxide compositions cement has exhibit different properties and different quite cement. The use of different raw materials , changing chemical composition, & use of additives have resulted the availability of many types of cements. Cement used in the experimental work is ORDIRARY PORTLAND CEMENT of 53 grades conforming to IS: 8112/1989.

2. AGGREGATES

Aggregates are the important constituents in concrete. They fill the volume of the concrete, effect economy and reduce shrinkage . The fact that the aggregates occupy 70-80 % of volume of concrete & it has some impact on various characteristics and properties of concrete. Earlier, aggregates were considered as chemically inert material but now it has been recognized that some of the aggregate are chemical

active and also certain aggregates ere exhibit chemical bond at the interface of aggregate and paste.

3. COARSE AGGREGATES

Crushed granite of 10mm and 20mm size are used as coarse aggregate.

4. FINE AGGREGATES

Fine aggregate which satisfied the specified properties for experimental work and conforms to zone as per the specification of IS: 383-1970.

5. WATER

Water plays an important role in achieving the strength of concrete. For complete hydration process it requires about 3/10th of its weight of water. It is proved that minimum water-cement ratio 0.35 is required for conventional concrete. Water participates in chemical reaction with cement & cement paste is formed and then binds with coarse and fine ggregates. If more water is employed , segregation and bleeding takes place, in order that the concrete becomes weak, but most of the water will absorb by the fibers. Hence it may avoid bleeding. bleeding will be caused If water content exceeds permissible limits. The required workability is not achieved, If less water is used. Portable water fit for drinking is required to be used in the concrete and the pH value should maintain in range between 6 to 9.

6. CERAMIC TILE AGGREGATE

Broken ceramic waste tiles were collected from the solid waste of ceramic manufacturing unit and from demolished building. The ceramic waste tiles were crushed into small pieces by manually and by using crusher. The required size of ceramic waste crushed tile aggregate was separated to use them as partial replacement for coarse aggregate. The tile waste which is less than 4.75 mm size was rejected. The crushed tile aggregate passing through 16.5mm sieve and retained on 12mm sieve are used for concrete purpose. the Crushed tiles were partially replaced in place of coarse aggregate by the different percentages such as 30%, 35% , 40% & 45% . This chapter deals with the presentation of test result, and discussion on compressive strength, tensile strength and flexural strength development of ceramic tile aggregate concrete over ordinary concrete at different percentage (0%,30%,35%,40% and 45%) and different curing period.

Ceramic Tile Aggregate Sample

V. RESULTS AND DISCUSSION

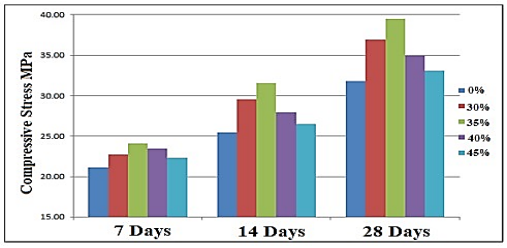
Slump Cone Test Result

The test was conducted for freshly prepared concrete conducted before the process of moulding. About 5 different ratios of concrete mixes are prepared at different times. for m25 grade of concrte, Workability Results obtained from slump cone

Compressive strength

The compressive strength is that the main criterion for the aim of structural design. The strength development in ceramic tile aggregate concrete studied at 7, 14 & 28 days. The variation of compressive strength with different percentage (0%,30%,35%,40% and 45%) of ceramic tile aggregate concrete over normal concrete. the concrete specimens casted has exhibited increase in compressive strength with increase duration of curing age. ceramic tile aggregate do enhance the static compressive strength of concrete, with increases in strength ranging from essentially nil to perhaps 24%. Even in members which contain conventional aggregate in addition to the ceramic tile aggregate, the ceramic tile aggregate has little effect on compressive strength. However, the ceramic tile aggregate does substantially increase the post-cracking ductility, or energy absorption of the material.

% CTA	7days N/mm²	14 days N/mm²	28 days N/mm²
0%	21.09	25.44	31.80
30%	22.07	29.55	36.94
35%	24.06	31.59	39.48
40%	23.47	27.95	34.94
45%	22.34	26.46	33.08

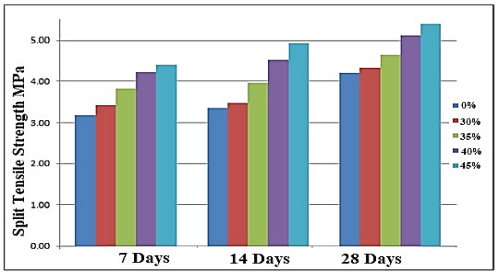


Comparison of compressive strength

Split Tensile Strength

The splitting tensile strength was determined at ages of 7 ,14& 28 days for moist cured concrete specimens. The test result of the splitting tensile strength is indicated that in general, all types of concrete specimens exhibited continued increase in splitting strength with development of curing ages. From graphs it is observed that the splitting tensile strength of ceramic tile aggregate concrete increases at all ages of curing compared with the ordinary concrete. This increase maybe ascribed to the significant reduction in capillary porosity of the cement matrix as well as a proper dispersion of the ceramic tile aggregate aligned in the direction of the tensile stress may bring about very large increases in direct tensile strength, as high as 28% for ceramic tile aggregate. However, for randomly distributed ceramic tile aggregate, the increase in strength is much smaller, ranging from as little as no increase in some instances to perhaps 40%, with many investigations indicating intermediate values. However, as in compression, ceramic tile aggregate does lead to major increases in the post-cracking behavior or toughness of the concrete.

%CTA	7 days N/mm^2	14 days N/mm^2	28 days N/mm^2
0%	3.177	3.36	4.21
30%	3.414	3.46	4.34
35%	3.814	3.95	4.65
40%	4.226	4.51	5.11
45%	4.407	4.93	5.39

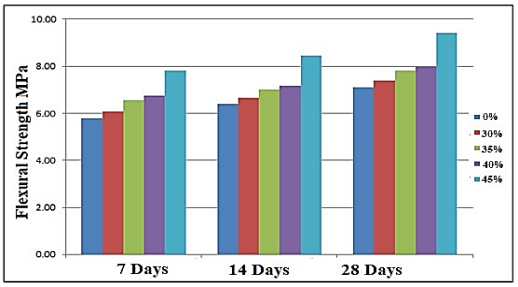


Comparison of Split Tensile Strength

Flexural Strength

It is found that the strength of concrete in tension and compression in both direction are closely related, but the relationship is not of direct proportionality. For higher compressive strength of concrete has higher tensile strength, but the rate of increase of the tensile strength is in increasing order. waste ceramic tile aggregate is generally found to have greater effect on the flexural strength of ceramic tile aggregate concrete than on either the compressive or tensile strength, with increases of more than 33.14% having been reported. The increases in flexural strength are particularly sensitive, not only to the ceramic tile aggregate volume, but also to the shape of the ceramic tile aggregate, with in proper shape leading to strength increases. For all the empirical measures of toughness, ceramic tile aggregate with lower bond characteristics gives lower toughness values than do smooth, proper shape ceramic tile aggregate at the same volume concentrations

%CTA	7days N/mm^2	14 days N/mm^2	28 days N/ mm^2
0%	5.80	6.0	7.12
30%	6.08	6.66	7.40
35%	6.56	7.02	7.82
40%	6.76	7.16	7.95
45%	7.8	8.46	9.48



Comparison ofFlexural Strength

VI. CONCLUSION

The usage of crushed waste marble floor tiles can also be studied as it is similar to that of tile waste generation and also it is quite hard compared to the natural crushed stones using in conventional concrete. A combination of different tiles (based on their usage) in different proportions in concrete and their effects on concrete properties like strength, workability etc., can be determined. The addition of ceramic tile aggregate effect on the compressive strength has increasing by 24.15% with (35%) of ceramic tile aggregate than start increasing and then decreases by with increase the ceramic tile aggregate quantities. The results of the splitting tensile strength tests show that, there is a increase in strength by increasing ceramic tile aggregate. it was found that highest splitting tensile strength was achieved by 45% of ceramic tile aggregate, which was found about 5.39 N/mm2 compared with other mix. The load carrying capacity is increased to 28.02 % compared with the conventional specimen. Based on the experimental test result there is an improvement in Flexural strength of the 2.5% mix is higher at age of 7,14& 28 days respectively compared to all other mixes. High quantities of ceramic tile aggregate produced concrete with better workability and segregation , lower entrapped air and lower unit weight. A significant effect on the mode and mechanism of failure of concrete cylinders during a comp. testing with

ceramic tile aggregate concrete. The (PCC) cylinders typically shatter due to an inability to absorb the energy by the test machine at failure. ceramic tile aggregate concrete cylinders continue to sustain load and enormous deformations without shattering into pieces.

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